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LONG-RANGE ICE OUTLOOK ANTARCTIC (1966-67)

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ABSTRACT

An outlook of expected sea ice conditions in the Ross Sea and McMurdo Sound regions of Antarctica is presented for the period mid-November 1966 through mid-January 1967. Oceanographic and climatic data for these areas were analyzed in terms of sea ice growth during the past austral winter. These analyses, combined with observed ice conditions for the period 3 through 8 October 1966 and a comprehensive study of historical ice and climatic information, formed the basis for the 1966-67 Ice Outlook. Evaluation of this information indicates that present ice conditions are similar to those observed during the 1964-65 season. In terms of the 1965-66 season, ice conditions are expected to be slightly heavier in the Ross Sea with less fast ice to be broken in McMurdo Sound.

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LONG-RANGE ICE OUTLOOK, ANTARCTIC (1966-67)

I. INTRODUCTION

The Long-Range Ice Outlook for DEEP FREEZE 67 presents a written and graphic description of expected ice conditions during the forthcoming operations of the Military Sea Transportation Service (MSTS) in Antarctica. Prognostic monthly ice charts showing the expected distribution of sea ice from mid-November through mid-January are presented.

The outlook is developed initially from a thorough evaluation of historical environmental data and from experience gained during previous DEEP FREEZE operations. Utilizing known empirical relationships, the character and distribution of ice developed during the winter season are quantitatively determined.

In addition, aerial reconnaissance of the Ross Sea-McMurdo Sound area from 3 to 8 October provides information on distribution, age, and roughness of the ice under consideration. A comparison is then made between the current environment and ice conditions experienced in preceding years to determine if an analogous situation exists. Place names used in this text are shown in figure 1.

II. ANALYSIS OF ENVIRONMENTAL DATA

Throughout the ice growth period, ice drift depends on mean sea-level circulation which is controlled by the path of the migrating pressure systems. The ice growth period is considered to extend from 15 April to 15 September. Owing to the lack of wind information over the Ross Sea, the ability to forecast ice drift becomes quite difficult. In order to help solve this problem, a series of points throughout the Ross Sea were selected, so that the mean wind velocity could be estimated from the daily weather charts in 15-day increments throughout the season of ice growth. Comparison of the 1965 wind data with this year's data indicates considerable changes throughout the area.

Vectors representing average ice drift for the entire ice growth period were computed for the selected points and are shown in figure 2. The arrow indicates the direction in which the ice is drifting, and the number on the arrow indicates the speed in nautical miles per day. Throughout the area, directions backed 45 to more than 90 degrees from last year's vectors. The greatest deviation occurred north of 70S where northeasterly ice drift was evident. Onshore drift was observed along the coast of Victoria Land from 76S to Cape Adare. The remainder of the area experienced northwest to northerly ice drift. Magnitudes were generally moderate, except north of 70S where magnitudes were light.

III. PRELIMINARY SURVEY OF ICE CONDITIONS

A. General

Preliminary aerial ice reconnaissance was made between 3 and 8 October 1966. C-121J and C-130E aircraft from Air Development Squadron 6 surveyed the ice conditions in the Ross Sea and McMurdo Sound. Results of these surveys are shown in figure 3. A legend of ice terminology and symbols is presented in figure 4.

B. Observed Ice Conditions

In McMurdo Sound ice concentrations were generally 9 to 10 tenths. The age was predominantly thick winter with secondary stages of medium winter and young ice. The fast ice boundary extended west-southwesterly from Cape Royds to the vicinity of 7740S,1640E, thence north-northwesterly 5 to 10 miles seaward of the Victoria Land coast. Adjacent to the fast ice and extending 15 miles northward was a considerable amount of young and medium winter ice.

From Franklin Island northward to the vicinity of 7330S, concentration was 10 tenths. The age consisted of 80 percent thick winter and 20 percent medium winter ice. Fast ice was observed in a 15- to 20-mile-wide band adjacent to the coast of Victoria Land from 7330S to 7430S.

Within the observed area between 66S and 7330S, the pack concentration was 9 tenths with 60 to 80 percent thick winter and the remainder medium winter and young ice. Heavy ridging was present throughout the observed area.

From 65S to 66S open pack concentrations consisted of 60 percent medium winter and 40 percent thick winter ice.

From 66S to 68S between 160E and 165E, ice concentrations ranged from 3 to 9 tenths with 50 percent thick and medium winter and 50 percent young and slush ice.

IV. OUTLOOK

A. General

Ice conditions determined from environmental conditions and confirmed by preliminary reconnaissance were quite similar to those observed during DEEP FREEZE 65. In addition, the temperature and wind regimes reflect conditions similar to the 1964-65 season. Accordingly, prognostic ice conditions for mid-November through mid-January, shown in figures 5 through 7, are similar to conditions observed during the 1964-65 season.

1. Outer Pack Boundary to 70S

By mid-November the outer pack boundary should extend from approximately 64S,160E eastward to 64S,180. Concentrations south of the boundary to 6730S should consist of mixed concentrations of open and close pack ice with very open pack ice from 65S to 6730S between 160E and 164E. From 6730S to 70S close pack concentrations containing 60 to 70 percent thick winter and moderately ridged ice will prevail.

The outer pack boundary should have receded to nearly 67S by mid-December with primarily open pack concentrations of thick and medium winter ice extending to 70S. Some close pack concentrations will remain in this area.

By mid-January the outer pack boundary should have receded to the vicinity of 68S with some open pack concentrations mixed with an extensive amount of very open pack ice extending to 70S.

2. 70S to 75S

Little change in presently observed ice conditions are expected by mid-November. However, by mid-December considerable disintegration should occur east of 173E. From 70S to 72S close pack concentrations consisting of 40 to 60 percent thick winter ice will be present. From 72S to 75S a considerable amount of open pack ice should be observed with some very open pack beginning near 75S. Heavily compacted ice will remain west of 173E owing to strong southerly and southeasterly winds.

By mid-January much open pack, open water, and ice free conditions will occur east of 173E.

3. 75S to Approaches to McMurdo Sound

During November, heavily ridged and compacted close pack ice should be observed from the coast of Victoria Land to the vicinity of Franklin Island. By the end of November open pack should be evident along the Ross Ice Shelf from Cape Crozier eastward to 180 and northward to 76S,170E.

Except for remnant pack ice along the coast of Victoria Land and along the north coast of Ross Island, this area should be essentially ice free by mid-January.

4. McMurdo Sound

By mid-November the fast ice boundary will extend westward from Cape Royds to 165E and then to the vicinity of Butter Point.

Owing to icebreaker operations, southerly winds, and warm air temperatures, the fast ice boundary should have retreated to the south of Winter Quarters Bay by mid-December and east of Cape Armitage by mid-January.

Depending on wind conditions, variable concentrations of young and medium winter ice will remain north of the fast ice boundary until mid-December.

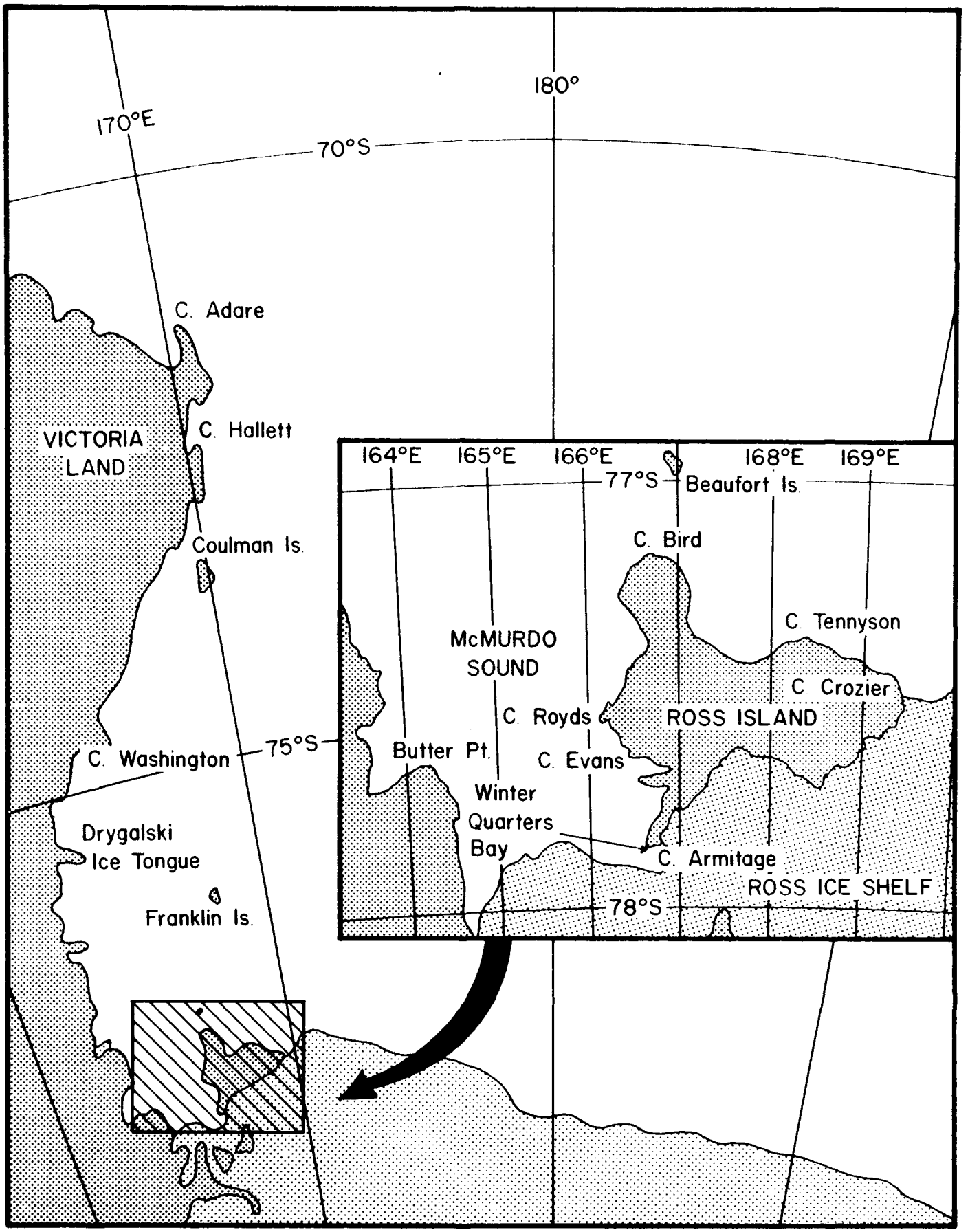

FIGURE 1 PLACE NAME CHART

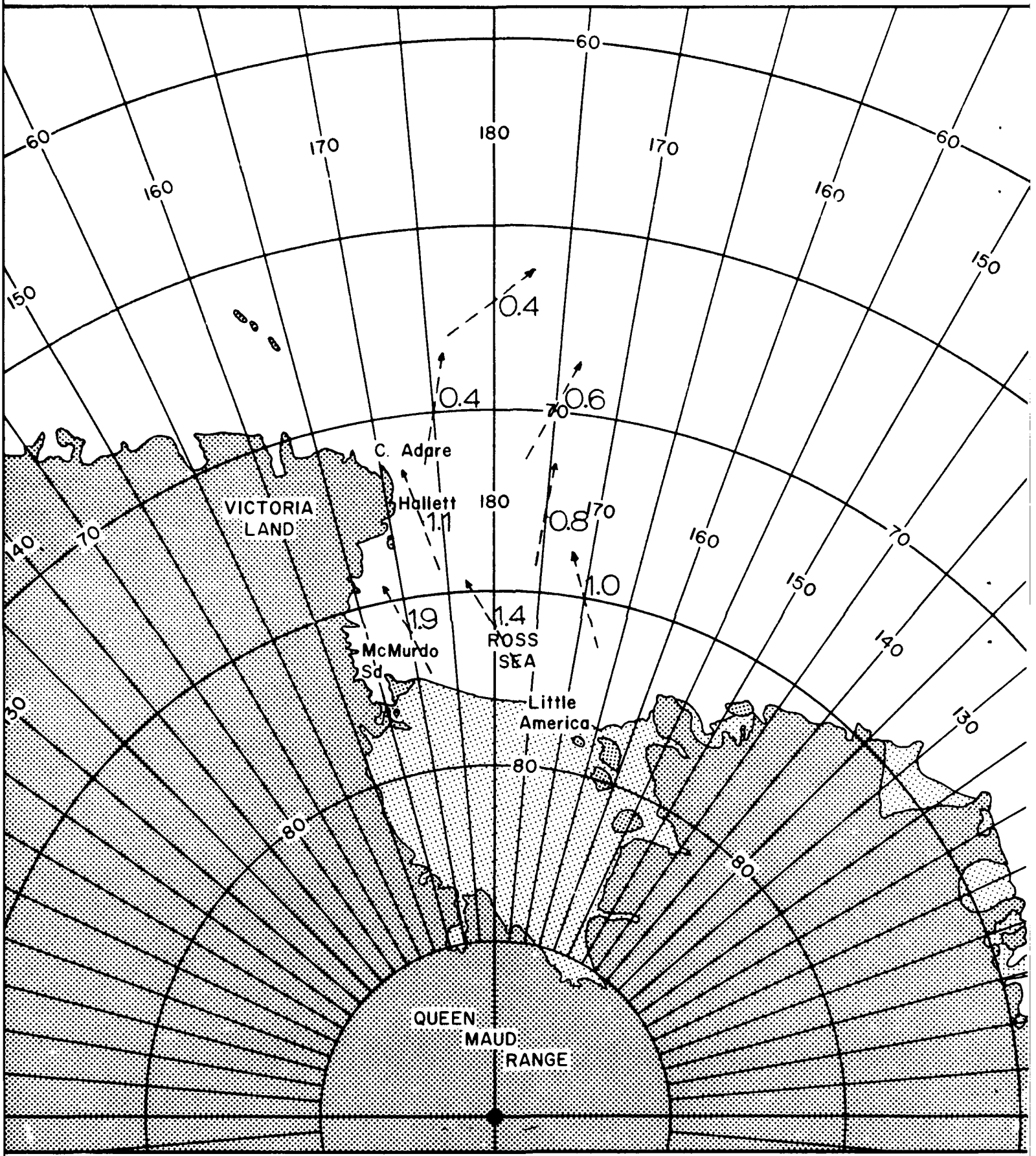

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FIGURE 2 COMPUTED MEAN ICE DRIFT 15 APRIL TO 15 SEPTEMBER 1966

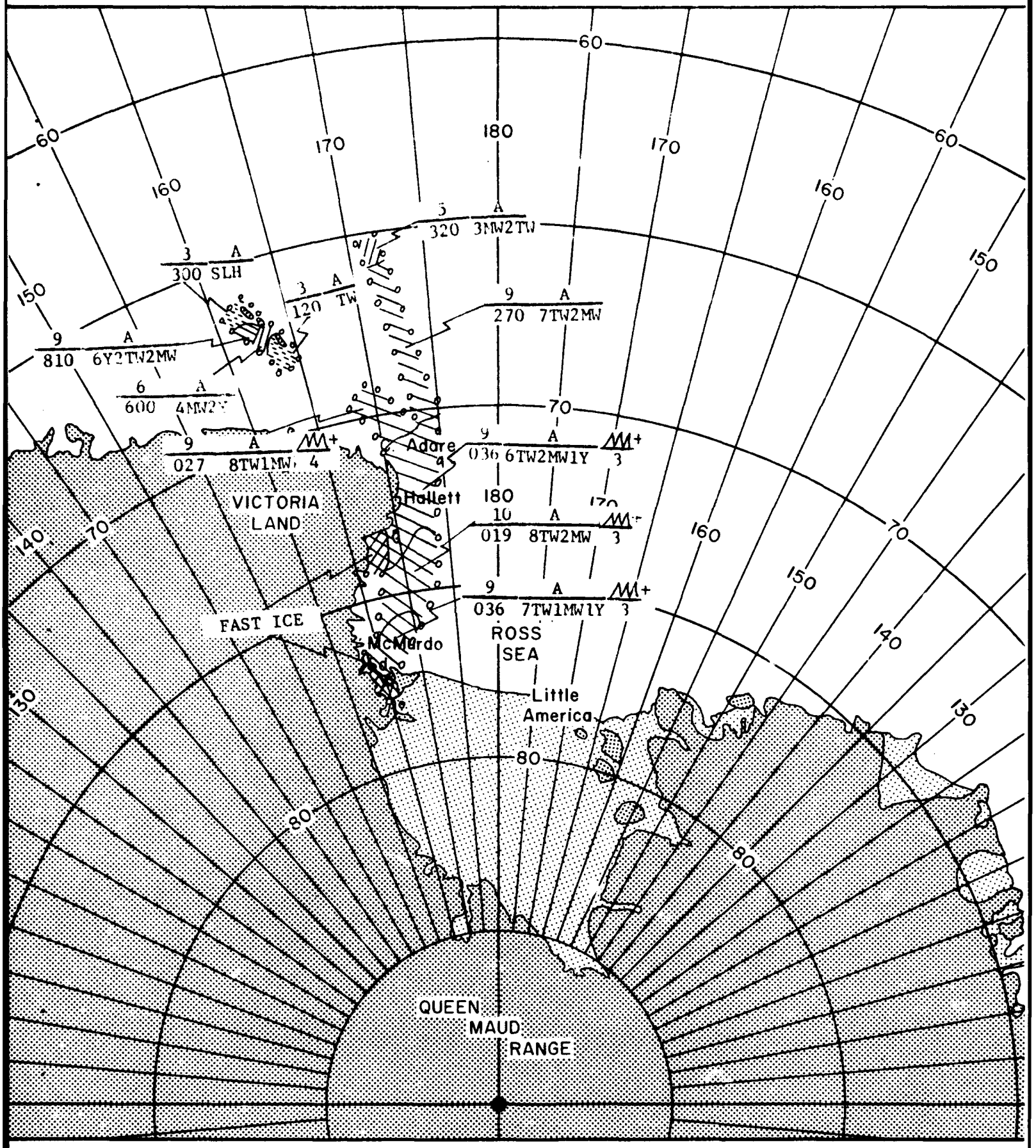

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FIGURE 3 OBSERVED ICE CONDITIONS 3-8 OCTOBER 1966

KEY TO ICE SYMBOLS

TOTAL CONCENTRATION

- Ice free
- 0 1 (open water)
- 0 1 thru 0 3 (very open pack)
- 0 4 thru 0 6 (open pack)
- 0 7 thru 0 9 (close pack)
- 1 0 fast or (very close pack)

BOUNDARY

- observed
- radar
- limit of observed data

TOPOGRAPHY

- rafted
- ridged
- hummocked

Examples (n) , (n)+

\+ after symbol indicates average height is 10 ft or greater

-- after symbol indicates average height is less than 10 ft

(n) tenths coverage on ice

COVERAGE BY SIZE

$$\frac{Cn}{n_1 n_2 n_3}$$

Cn = total concentration

n_1	SL =	Slush	
	BSH =	Brash	<2m (<6.6 ft)
	SCAKE =	Small Ice Cake	<2m (<6.6 ft)
	PK =	Pancake Ice	30 cm—3 m (12 in—9.8 ft)
	CAKE =	Ice Cake	<10 m (<32.8 ft)
n_2	SMF =	Small Ice Floe	10—200 m (32.8—656 ft)
	MDF =	Medium Ice Floe	200—1,000 m (656—3,281 ft)
n_3	BGF =	Big Ice Floe	1—<10 km (3,281 ft—<5.4 nm)
	VAF =	Vast Ice Floe	>10 km (>5.4 nm)

Example:

$\frac{9}{243}$ BSH

9 = total concentration
2 = tenths all brash ice
4 = tenths, small and medium ice floes
3 = tenths, big and vast ice floes

STAGE OF DEVELOPMENT

$$\frac{A}{\text{tenths predominant, tenths secondary}}$$

AGE		AVERAGE THICKNESS
IC =	Ice Crystals	
SL =	Slush	<5 cm (<2 in)
IR =	Ice Rind	<5 cm (<2 in)
PK =	Pancake	<5 cm (<2 in)
Y =	Young	5—15 cm (2—6 in)
MW =	Medium Winter	15—30 cm (6—12 in)
TW =	Thick Winter	>30 cm (>12 in)
WT =	Winter	15 cm—2 m (6 in—6.6 ft)
PL =	Polar	<3 m (<9.8 ft)
YP =	Young Polar	<2.5 m (<8.2 ft)
AP =	Arctic Pack	>2.5 m (>8.2 ft)

Example: $\frac{A}{7MW3SL}$

A = Stage of development
7MW = 7 tenths Medium Winter
3SL = 3 tenths Slush

STAGE OF MELTING

$$\frac{PD}{(n) + (n)\,F}$$

PD = puddling

(n) = tenths coverage on ice

(n) F = tenths coverage on ice, Frozen

Examples

$\frac{PD}{3}$ = 3 tenths puddling

$\frac{PD}{3F}$ = 3 tenths frozen puddles

$\frac{TH}{(n)}$ = thaw holes — same entry procedure as above

UNDERCAST

- Limit

THICKNESS OF ICE AND SNOW

$\frac{T}{n}$ = ice thickness in inches

$\frac{SD}{n}$ = snow depth in inches

$\frac{S}{n}$ = snow cover in tenths

PHENOMENA

- crack
- polynya
- lead
- (n) icebergs
- (n) bergy bits & growlers

(n) = number in area

FIGURE 4

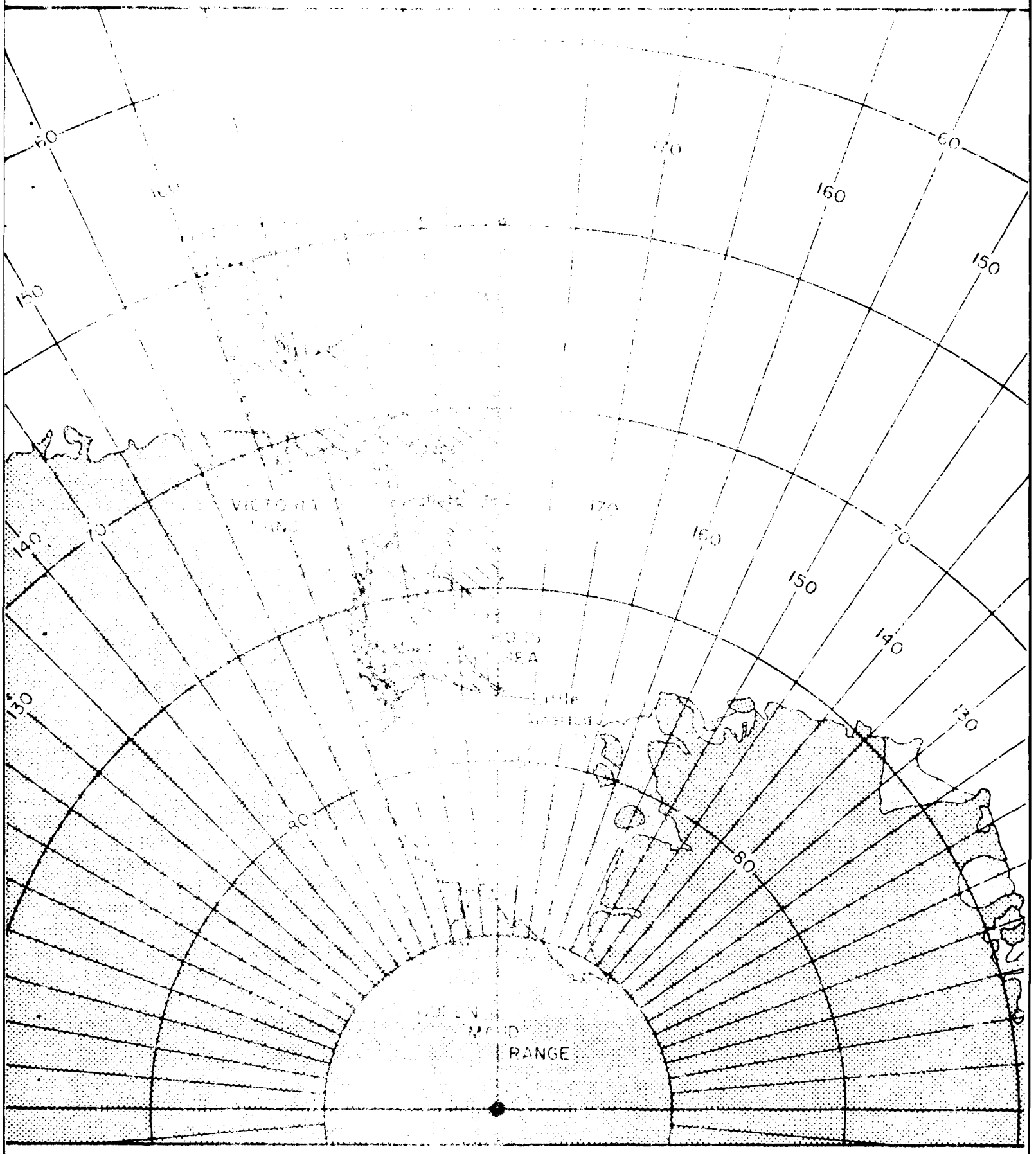

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FIGURE 5 PROGNOSTIC ICE CHART MID-NOVEMBER 1966

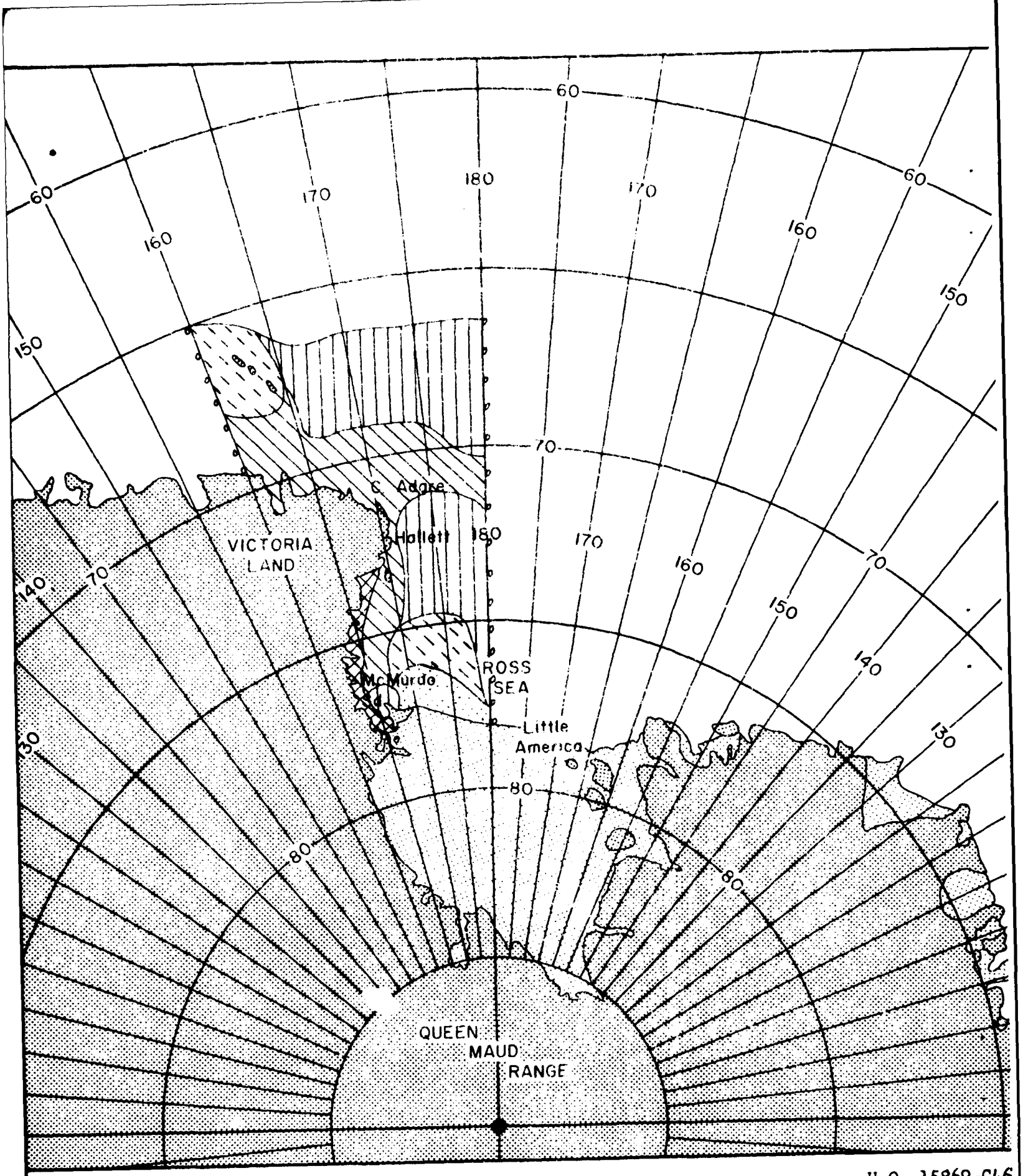

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FIGURE 6 PROGNOSTIC ICE CHART MID-DECEMBER 1966

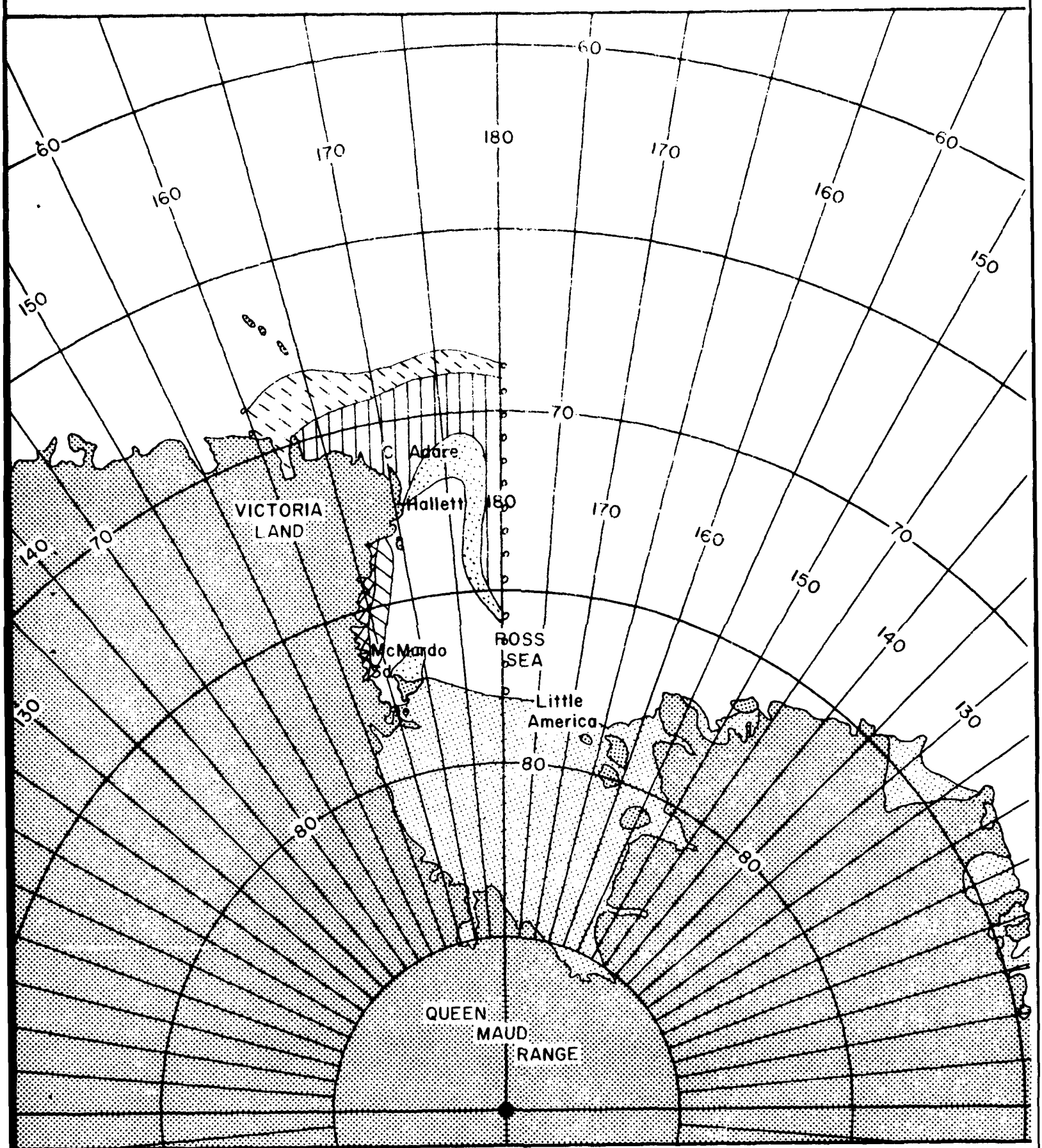

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FIGURE 7 PROGNOSTIC ICE CHART MID-JANUARY 1967

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1. Ice Forecasting, Antarctic
2. Ice Distribution, Antarctic
3. Climate, Antarctic
4. McMurdo Sound
5. Ross Sea

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